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U.S. Environmental Protection Agency, December 14, 1990, Hazard Ranking System, Final Rule, 40 CFR Part 300, 16 pages excerpted. A full copy of the HRS Rule is available in the Regional docket, upon request.

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Part II

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40 CFR Part 300
Hazard Ranking System; Final Rule

Appendix A to Part 300—The Hazard Ranking System

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• Soil exposure—resident population threat.

–All hazardous substances that meet the criteria for observed contamination at the site (see section 5.0.1).

• Soil exposure—nearby population threat.

–All hazardous substances that meet the criteria for observed contamination at areas with an attractiveness/accessibility factor value greater than 0 (see section 5.2.1.1).

2.3 *Likelihood of release.* Likelihood of release is a measure of the likelihood that a waste has been or will be released to the environment. The likelihood of release factor category is assigned the maximum value of 550 for a migration pathway whenever the criteria for an observed release are met for that pathway. If the criteria for an observed release are met, do not evaluate potential to release for that pathway. When the criteria for an observed release are not met, evaluate potential to release for that pathway, with a maximum value of 500. The evaluation of potential to release varies by migration pathway (see sections 3, 4 and 6).

Establish an observed release either by direct observation of the release of a hazardous substance into the media being evaluated (for example, surface water) or by chemical analysis of samples appropriate to the pathway being evaluated (see sections 3, 4, and 6). The minimum standard to establish an observed release by chemical analysis is analytical evidence of a hazardous substance in the media significantly above the background level. Further, some portion of the release must be attributable to the site. Use the criteria in Table 2–3 as the standard for determining analytical significance. (The criteria in Table 2–3 are also used in establishing observed contamination for the soil exposure pathway, see section 5.0.1.) Separate criteria apply to radionuclides (see section 7.1.1).

TABLE 2–3.—OBSERVED RELEASE CRITERIA FOR CHEMICAL ANALYSIS

Sample Measurement < Sample Quantitation Limit [a]
No observed release is established.
Sample Measurement ≥ SAMPLE QUANTITATION LIMIT [a]
An observed release is established as follows: • If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit.[a] • If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is 3 times or more above the background concentration.

[a] If the sample quantitation limit (SQL) cannot be established, determined if there is an observed release as follows:

—If the sample analysis was performed under the EPA Contract Laboratory Program, use the EPA contract-required quantitation limit (CRQL) in place of the SQL.

—If the sample analysis is not performed under the EPA Contract Laboratory Program, use the detection limit (DL) in place of the SQL.

2.4 *Waste characteristics.* The waste characteristics factor category includes the following factors: hazardous waste quantity, toxicity, and as appropriate to the pathway or threat being evaluated, mobility, persistence, and/or bioaccumulation (or ecosystem bioaccumulation) potential.

2.4.1 *Selection of substance potentially posing greatest hazard.* For all pathways (and threats), select the hazardous substance potentially posing the greatest hazard for the pathway (or threat) and use that substance in evaluating the waste characteristics category of the pathway (or threat). For the three migration pathways (and threats), base the selection of this hazardous substance on the toxicity factor value for the substance, combined with its mobility, persistence, and/or bioaccumulation (or ecosystem bioaccumulation) potential factor values, as applicable to the migration pathway (or threat). For the soil exposure pathway, base the selection on the toxicity factor alone.

Evaluation of the toxicity factor is specified in section 2.4.1.1. Use and evaluation of the mobility, persistence, and/or bioaccumulation (or ecosystem bioaccumulation) potential factors vary by pathway (or threat) and are specified under the appropriate pathway (or threat) section. Section 2.4.1.2 identifies the specific factors that are combined with toxicity in evaluating each pathway (or threat).

2.4.1.1 *Toxicity factor.* Evaluate toxicity for those hazardous substances at the site that are available to the pathway being scored. For all pathways and threats, except the surface water environmental threat, evaluate human toxicity as specified below. For the surface water environmental threat, evaluate ecosystem toxicity as specified in section 4.1.4.2.1.1.

Establish human toxicity factor values based on quantitative dose-response parameters for the following three types of toxicity:

• Cancer– –Use slope factors (also referred to as cancer potency factors) combined with weight-of-evidence ratings for carcinogenicity. If a slope factor is not available for a substance, use its ED_{10} value to estimate a slope factor as follows:

$$\text{Slope factor} = \frac{1}{6\ (ED_{10})}$$

• Noncancer toxicological responses of chronic exposure– –use reference dose (RfD) values.

• Noncancer toxicological responses of acute exposure– –use acute toxicity parameters, such as the LD_{50}.

Assign human toxicity factor values to a hazardous substance using Table 2–4, as follows:

• If RfD and slope factor values are both available for the hazardous substance, assign the substance a value from Table 2–4 for each. Select the higher of the two values assigned and use it as the overall toxicity factor value for the hazardous substance.

• If either an RfD or slope factor value is available, but not both, assign the hazardous substance an overall toxicity factor value from Table 2–4 based solely on the available value (RfD or slope factor).

• If neither an RfD nor slope factor value is available, assign the hazardous substance an overall toxicity factor value from Table 2–4 based solely on acute toxicity. That is, consider acute toxicity in Table 2–4 only when both RfD and slope factor values are not available.

• If neither an RfD, nor slope factor, nor acute toxicity value is available, assign the hazardous substance an overall toxicity factor value of 0 and use other hazardous substances for which information is available in evaluating the pathway.

TABLE 2–4.—TOXICITY FACTOR EVALUATION

Chronic Toxicity (Human)

Reference dose (RfD) (mg/kg-day)	Assigned value
RfD < 0.0005	10,000
0.0005 ≤ RfD < 0.005	1,000
0.005 ≤ RfD < 0.05	100
0.05 ≤ RfD < 0.5	10
0.5 ≤ RfD	1
RfD not available	0

Carcinogenicity (Human)

Weight-of-evidence[a]/slope factor (mg/kg-day)$^{-1}$			Assigned value
A	B	C	
0.5 ≤ SF[b]	.5 ≤ SF	50 ≤ SF	10,000
0.05 ≤ SF < 0.5	0.5 ≤ SF < 5	5 ≤ SF < 50	1,000
SF < 0.05	0.05 ≤ SF < 0.5	0.5 ≤ SF < 5	100
— — —	SF < 0.05	SF < 0.5	10
Slope factor not available.	Slope factor not available.	Slope factor not available.	0

[a] A, B, and C refer to weight-of-evidence categories. Assign substances with a weight-of-evidence category of D (inadequate evidence of carcinogenicity) or E (evidence of lack of carcinogenicity) a value of 0 for carcinogenicity.

[b] SF = Slope factor.

TABLE 2-4.—TOXICITY FACTOR EVALUATION—CONCLUDED

Acute Toxicity (Human)

Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Dust or mist LC_{50} (mg/l)	Gas or vapor LC_{50} (ppm)	Assigned value
$LD_{50} < 5$	$LD_{50} < 2$	$LC_{50} < 0.2$	$LC_{50} < 20$	1,000
$5 \leq LD_{50} < 50$	$2 \leq LD_{50} < 20$	$0.2 \leq LC_{50} < 2$	$20 \leq LC_{50} < 200$	100
$50 \leq LD_{50} < 500$	$20 \leq LD_{50} < 200$	$2 \leq LC_{50} < 20$	$200 \leq LC_{50} < 2,000$	10
$500 \leq LD_{50}$	$200 \leq LD_{50}$	$20 \leq LC_{50}$	$2,000 \leq LC_{50}$	1
LD_{50} not available	LD_{50} not available	LC_{50} not available	LC_{50} not available	0

If a toxicity factor value of 0 is assigned to all hazardous substances available to a particular pathway (that is, insufficient toxicity data are available for evaluating all the substances), use a default value of 100 as the overall human toxicity factor value for all hazardous substances available to the pathway. For hazardous substances having usable toxicity data for multiple exposure routes (for example, inhalation and ingestion), consider all exposure routes and use the highest assigned value, regardless of exposure route, as the toxicity factor value.

For HRS purposes, assign both asbestos and lead (and its compounds) a human toxicity factor value of 10,000.

Separate criteria apply for assigning factor values for human toxicity and ecosystem toxicity for radionuclides (see sections 7.2.1 and 7.2.2).

2.4.1.2 *Hazardous substance selection.* For each hazardous substance evaluated for a migration pathway (or threat), combine the human toxicity factor value (or ecosystem toxicity factor value) for the hazardous substance with a mobility, persistence, and/or bioaccumulation (or ecosystem bioaccumulation) potential factor value as follows:

- Ground water migration.
  - –Determine a combined human toxicity/mobility factor value for the hazardous substance (see section 3.2.1).
- Surface water migration-overland/flood migration component.
  - –Determine a combined human toxicity/persistence factor value for the hazardous substance for the drinking water threat (see section 4.1.2.2.1).
  - –Determine a combined human toxicity/persistence/bioaccumulation factor value for the hazardous substance for the human food chain threat (see section 4.1.3.2.1).
  - –Determine a combined ecosystem toxicity/persistence/bioaccumulation factor value for the hazardous substance for the environmental threat (see section 4.1.4.2.1).
- Surface water migration-ground water to surface water migration component.
  - –Determine a combined human toxicity/mobility/persistence factor value for the hazardous substance for the drinking water threat (see section 4.2.2.2.1).
  - –Determine a combined human toxicity/mobility/persistence/bioaccumulation factor value for the hazardous substance for the human food chain threat (see section 4.2.3.2.1).
  - –Determine a combined ecosystem toxicity/mobility/persistence/bioaccumulation factor value for the hazardous substance for the environmental threat (see section 4.2.4.2.1).
- Air migration.
  - –Determine a combined human toxicity/mobility factor value for the hazardous substance (see section 6.2.1).

Determine each combined factor value for a hazardous substance by multiplying the individual factor values appropriate to the pathway (or threat). For each migration pathway (or threat) being evaluated, select the hazardous substance with the highest combined factor value and use that substance in evaluating the waste characteristics factor category of the pathway (or threat).

For the soil exposure pathway, select the hazardous substance with the highest human toxicity factor value from among the substances that meet the criteria for observed contamination for the threat evaluated and use that substance in evaluating the waste characteristics factor category.

2.4.2 *Hazardous waste quantity.* Evaluate the hazardous waste quantity factor by first assigning each source (or area of observed contamination) a source hazardous waste quantity value as specified below. Sum these values to obtain the hazardous waste quantity factor value for the pathway being evaluated.

In evaluating the hazardous waste quantity factor for the three migration pathways, allocate hazardous substances and hazardous wastestreams to specific sources in the manner specified in section 2.2.2, except: consider hazardous substances and hazardous wastestreams that cannot be allocated to any specific source to constitute a separate "unallocated source" for purposes of evaluating only this factor for the three migration pathways. Do not, however, include a hazardous substance or hazardous wastestream in the unallocated source for a migration pathway if there is definitive information indicating that the substance or wastestream could only have been placed in sources with a containment factor value of 0 for that migration pathway.

In evaluating the hazardous waste quantity factor for the soil exposure pathway, allocate to each area of observed contamination only those hazardous substances that meet the criteria for observed contamination for that area of observed contamination and only those hazardous wastestreams that contain hazardous substances that meet the criteria for observed contamination for that area of observed contamination. Do not consider other hazardous substances or hazardous wastestreams at the site in evaluating this factor for the soil exposure pathway.

2.4.2.1 *Source hazardous waste quantity.* For each of the three migration pathways, assign a source hazardous waste quantity value to each source (including the unallocated source) having a containment factor value greater than 0 for the pathway being evaluated. Consider the unallocated source to have a containment factor value greater than 0 for each migration pathway.

For the soil exposure pathway, assign a source hazardous waste quantity value to each area of observed contamination, as applicable to the threat being evaluated.

For all pathways, evaluate source hazardous waste quantity using the following four measures in the following hierarchy:

- Hazardous constituent quantity.
- Hazardous wastestream quantity.
- Volume.
- Area.

For the unallocated source, use only the first two measures.

Separate criteria apply for assigning a source hazardous waste quantity value for radionuclides (see section 7.2.5).

2.4.2.1.1 *Hazardous constituent quantity.* Evaluate hazardous constituent quantity for the source (or area of observed contamination) based solely on the mass of CERCLA hazardous substances (as defined in CERCLA section 101(14), as amended) allocated to the source (or area of observed contamination), except:

- For a hazardous waste listed pursuant to section 3001 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (RCRA), 42 U.S.C. 6901 et seq., determine its mass for the evaluation of this measure as follows:
  - –If the hazardous waste is listed solely for Hazard Code T (toxic waste), include only the mass of constituents in the hazardous waste that are CERCLA hazardous substances and not the mass of the entire hazardous waste.
  - –If the hazardous waste is listed for any other Hazard Code (including T plus any other Hazard Code), include the mass of the entire hazardous waste.
- For a RCRA hazardous waste that exhibits the characteristics identified under section 3001 of RCRA, as amended, determine its mass for the evaluation of this measure as follows:

–If the hazardous waste exhibits only the characteristic of toxicity (or only the characteristic of EP toxicity), include only the mass of constituents in the hazardous waste that are CERCLA hazardous substances and not the mass of the entire hazardous waste.
–If the hazardous waste exhibits any other characteristic identified under section 3001 (including any other characteristic plus the characteristic of toxicity [or the characteristic of EP toxicity]), include the mass of the entire hazardous waste.

Based on this mass, designated as C, assign a value for hazardous constituent quantity as follows:

• For the migration pathways, assign the source a value for hazardous constituent quantity using the Tier A equation of Table 2–5.

• For the soil exposure pathway, assign the area of observed contamination a value using the Tier A equation of Table 5–2 (section 5.1.2.2).

If the hazardous constituent quantity for the source (or area of observed contamination) is adequately determined (that is, the total mass of all CERCLA hazardous substances in the source and releases from the source [or in the area of observed contamination] is known or is estimated with reasonable confidence), do not evaluate the other three measures discussed below. Instead assign these other three measures a value of 0 for the source (or area of observed contamination) and proceed to section 2.4.2.1.5.

If the hazardous constituent quantity is not adequately determined, assign the source (or area of observed contamination) a value for hazardous constituent quantity based on the available data and proceed to section 2.4.2.1.2.

TABLE 2–5.—HAZARDOUS WASTE QUANTITY EVALUATION EQUATIONS

Tier	Measure	Units	Equation for assigning value [a]
A	**Hazardous constituent quantity (C)**	lb	C
B [b]	**Hazardous wastestream quantity (W)**	lb	W/5,000
C [b]	**Volume (V)**		
	Landfill	yd^3	V/2,500
	Surface impoundment	yd^3	V/2.5
	Surface impoundment (buried/backfilled)	yd^3	V/2.5
	Drums [c]	gallon	V/500
	Tanks and containers other than drums	yd^3	V/2.5
	Contaminated soil	yd^3	V/2,500
	Pile	yd^3	V/2.5
	Other	yd^3	V/2.5
D [b]	**Area (A)**		
	Landfill	ft^2	A/3,400
	Surface impoundment	ft^2	A/13
	Surface impoundment (buried/backfilled)	ft^2	A/13
	Land treatment	ft^2	A/270
	Pile [d]	ft^2	A/13
	Contaminated soil	ft^2	A/34,000

[a] Do not round to nearest integer.
[b] Convert volume to mass when necessary: 1 ton=2,000 pounds=1 cubic yard=4 drums=200 gallons.
[c] If actual volume of drums is unavailable, assume 1 drum=50 gallons.
[d] Use land surface area under pile, not surface area of pile.

2.4.2.1.2 *Hazardous wastestream quantity.* Evaluate hazardous wastestream quantity for the source (or area of observed contamination) based on the mass of hazardous wastestreams plus the mass of any additional CERCLA pollutants and contaminants (as defined in CERCLA section 101[33], as amended) that are allocated to the source (or area of observed contamination). For a wastestream that consists solely of a hazardous waste listed pursuant to section 3001 of RCRA, as amended or that consists solely of a RCRA hazardous waste that exhibits the characteristics identified under section 3001 of RCRA, as amended, include the mass of that entire hazardous waste in the evaluation of this measure.

Based on this mass, designated as W, assign a value for hazardous wastestream quantity as follows:

• For the migration pathways, assign the source a value for hazardous wastestream quantity using the Tier B equation of Table 2–5.

• For the soil exposure pathway, assign the area of observed contamination a value using the Tier B equation of Table 5–2 (section 5.1.2.2).

Do not evaluate the volume and area measures described below if the source is the unallocated source or if the following condition applies:

• The hazardous wastestream quantity for the source (or area of observed contamination) is adequately determined—that is, total mass of all hazardous wastestreams and CERCLA pollutants and contaminants for the source and releases from the source (or for the area of observed contamination) is known or is estimated with reasonable confidence.

If the source is the unallocated source or if this condition applies, assign the volume and area measures a value of 0 for the source (or area of observed contamination) and proceed to section 2.4.2.1.5. Otherwise, assign the source (or area of observed contamination) a value for hazardous wastestream quantity based on the available data and proceed to section 2.4.2.1.3.

2.4.2.1.3 *Volume.* Evaluate the volume measure using the volume of the source (or the volume of the area of observed contamination). For the soil exposure pathway, restrict the use of the volume measure to those areas of observed contamination specified in section 5.1.2.2.

Based on the volume, designated as V, assign a value to the volume measure as follows:

• For the migration pathways, assign the source a value for volume using the appropriate Tier C equation of Table 2–5.

• For the soil exposure pathway, assign the area of observed contamination a value for volume using the appropriate Tier C equation of Table 5–2 (section 5.1.2.2).

If the volume of the source (or volume of the area of observed contamination, if applicable) can be determined, do not evaluate the area measure. Instead, assign the area measure a value of 0 and proceed to section 2.4.2.1.5. If the volume cannot be determined (or is not applicable for the soil exposure pathway), assign the source (or area of observed contamination) a value of 0 for the volume measure and proceed to section 2.4.2.1.4.

2.4.2.1.4 *Area.* Evaluate the area measure using the area of the source (or the area of the area of observed contamination). Based on this area, designated as A, assign a value to the area measure as follows:

• For the migration pathways, assign the source a value for area using the appropriate Tier D equation of Table 2–5.

• For the soil exposure pathway, assign the area of observed contamination a value for area using the appropriate Tier D equation of Table 5–2 (section 5.1.2.2).

2.4.2.1.5 *Calculation of source hazardous waste quantity value.* Select the highest of the values assigned to the source (or area of observed contamination) for the hazardous constituent quantity, hazardous wastestream quantity, volume, and area measures. Assign this value as the source hazardous waste quantity value. Do not round to the nearest integer.

2.4.2.2 *Calculation of hazardous waste quantity factor value.* Sum the source hazardous waste quantity values assigned to all sources (including the unallocated source) or areas of observed contamination for the pathway being evaluated and round this sum to the nearest integer, except: if the sum is greater than 0, but less than 1, round it to 1. Based on this value, select a hazardous waste quantity factor value for the pathway from Table 2–6.

TABLE 2–6.—HAZARDOUS WASTE QUANTITY FACTOR VALUES

Hazardous waste quantity value [a]	Assigned value
0	0
1 [b] to 100	1 [c]
Greater than 100 to 10,000	100
Greater than 10,000 to 1,000,000	10,000
Greater than 1,000,000	1,000,000

[a] If the hazardous waste quantity value is greater than 0, but less than 1, round it to 1 as specified in text.
[b] For the pathway, if hazardous constituent quantity is not adequately determined, assign a value as specified in the text; do not assign the value of 1.

For a migration pathway, if the hazardous constituent quantity is adequately determined (see section 2.4.2.1.1) for all sources (or all portions of sources and releases remaining after a removal action), assign the value from Table 2–6 as the hazardous waste quantity factor value for the pathway. If the hazardous constituent quantity is not adequately determined for one or more sources (or one or more portions of sources or releases remaining after a removal action) assign a factor value as follows:

- If any target for that migration pathway is subject to Level I or Level II concentrations (see section 2.5), assign either the value from Table 2–6 or a value of 100, whichever is greater, as the hazardous waste quantity factor value for that pathway.
- If none of the targets for that pathway is subject to Level I or Level II concentrations, assign a factor value as follows:
  - If there has been no removal action, assign either the value from Table 2–6 or a value of 10, whichever is greater, as the hazardous waste quantity factor value for that pathway.
  - If there has been a removal action:
    - Determine values from Table 2–6 with and without consideration of the removal action.
    - If the value that would be assigned from Table 2–6 without consideration of the removal action would be 100 or greater, assign either the value from Table 2–6 with consideration of the removal action or a value of 100, whichever is greater, as the hazardous waste quantity factor value for the pathway.
    - If the value that would be assigned from Table 2–6 without consideration of the removal action would be less than 100, assign a value of 10 as the hazardous waste quantity factor value for the pathway.

For the soil exposure pathway, if the hazardous constituent quantity is adequately determined for all areas of observed contamination, assign the value from Table 2–6 as the hazardous waste quantity factor value. If the hazardous constituent quantity is not adequately determined for one or more areas of observed contamination, assign either the value from Table 2–6 or a value of 10, whichever is greater, as the hazardous waste quantity factor value.

2.4.3 *Waste characteristics factor category value.* Determine the waste characteristics factor category value as specified in section 2.4.3.1 for all pathways and threats, except the surface water-human food chain threat and the surface water-environmental threat. Determine the waste characteristics factor category value for these latter two threats as specified in section 2.4.3.2.

2.4.3.1 *Factor category value.* For the pathway (or threat) being evaluated, multiply the toxicity or combined factor value, as appropriate, from section 2.4.1.2 and the hazardous waste quantity factor value from section 2.4.2.2, subject to a maximum product of 1×10^8. Based on this waste characteristics product, assign a waste characteristics factor category value to the pathway (or threat) from Table 2–7.

TABLE 2–7.—WASTE CHARACTERISTICS FACTOR CATEGORY VALUES

Waste characteristics product	Assigned value
0	0
Greater than 0 to less than 10	1
10 to less than 1×10^2	2
1×10^2 to less than 1×10^3	3
1×10^3 to less than 1×10^4	6
1×10^4 to less than 1×10^5	10
1×10^5 to less than 1×10^6	18
1×10^6 to less than 1×10^7	32
1×10^7 to less than 1×10^8	56
1×10^8 to less than 1×10^9	100
1×10^9 to less than 1×10^{10}	180
1×10^{10} to less than 1×10^{11}	320
1×10^{11} to less than 1×10^{12}	560
1×10^{12}	1,000

2.4.3.2 *Factor category value, considering bioaccumulation potential.* For the surface water-human food chain threat and the surface water-environmental threat, multiply the toxicity or combined factor value, as appropriate, from section 2.4.1.2 and the hazardous waste quantity factor value from section 2.4.2.2, subject to:

- A maximum product of 1×10^{12}, *and*
- A maximum product exclusive of the bioaccumulation (or ecosystem bioaccumulation) potential factor of 1×10^8.

Based on the total waste characteristics product, assign a waste characteristics factor category value to these threats from Table 2–7.

2.5 *Targets.*

The types of targets evaluated include the following:

- Individual (factor name varies by pathway and threat).
- Human population.
- Resources (these vary by pathway and threat).
- Sensitive environments (included for all pathways except ground water migration).

The factor values that may be assigned to each type of target have the same range for each pathway for which that type of target is evaluated. The factor value for most types of targets depends on whether the target is subject to actual or potential contamination for the pathway and whether the actual contamination is Level I or Level II:

- Actual contamination: Target is associated either with a sampling location that meets the criteria for an observed release (or observed contamination) for the pathway or with an observed release based on direct observation for the pathway (additional criteria apply for establishing actual contamination for the human food chain threat in the surface water migration pathway, see sections 4.1.3.3 and 4.2.3.3). sections 3 through 6 specify how to determine the targets associated with a sampling location or with an observed release based on direct observation. Determine whether the actual contamination is Level I or Level II as follows:
  - Level I:
    - Media-specific concentrations for the target meet the criteria for an observed release (or observed contamination) for the pathway and are at or above media-specific benchmark values. These benchmark values (see section 2.5.2) include both screening concentrations and concentrations specified in regulatory limits (such as Maximum Contaminant Level (MCL) values), or
    - For the human food chain threat in the surface water migration pathway, concentrations in tissue samples from aquatic human food chain organisms are at or above benchmark values. Such tissue samples may be used in addition to media-specific concentrations only as specified in sections 4.1.3.3 and 4.2.3.3.
  - Level II:
    - Media-specific concentrations for the target meet the criteria for an observed release (or observed contamination) for the pathway, but are less than media-specific benchmarks. If none of the hazardous substances eligible to be evaluated for the sampling location has an applicable benchmark, assign Level II to the actual contamination at the sampling location, or
    - For observed releases based on direct observation, assign Level II to targets as specified in sections 3, 4, and 6, or
    - For the human food chain threat in the surface water migration pathway, concentrations in tissue samples from aquatic human food chain organisms, when applicable, are below benchmark values.
  - If a target is subject to both Level I and Level II concentrations for a pathway (or threat), evaluate the target using Level I concentrations for that pathway (or threat).
- Potential contamination: Target is subject to a potential release (that is, target is not associated with actual contamination for that pathway or threat).

Assign a factor value for individual risk as follows (select the highest value that applies to the pathway or threat):

- 50 points if any individual is exposed to Level I concentrations.
- 45 points if any individual is exposed to Level II concentrations.
- Maximum of 20 points if any individual is subject to potential contamination. The value assigned is 20 multiplied by the distance or dilution weight appropriate to the pathway.

Assign factor values for population and sensitive environments as follows:

- Sum Level I targets and multiply by 10. (Level I is not used for sensitive environments in the soil exposure and air migration pathways.)
- Sum Level II targets.
- Multiply potential targets by distance or dilution weights appropriate to the pathway, sum, and divide by 10. Distance or dilution weighting accounts for diminishing exposure

the hazardous substance with the highest toxicity/persistence factor value for the watershed to assign the toxicity/persistence factor value for the drinking water threat for the watershed. Enter this value in Table 4–1.

4.1.2.2.2 *Hazardous waste quantity.* Assign a hazardous waste quantity factor value for the watershed as specified in section 2.4.2. Enter this value in Table 4–1.

4.1.2.2.3 *Calculation of drinking water threat-waste characteristics factor category value.* Multiply the toxicity/persistence and hazardous waste quantity factor values for the watershed, subject to a maximum product of 1×10^8. Based on this product, assign a value from Table 2–7 (section 2.4.3.1) to the drinking water threat-waste characteristics factor category for the watershed. Enter this value in Table 4–1.

TABLE 4–12.—TOXICITY/PERSISTENCE FACTOR VALUES [a]

Persistence factor value	Toxicity factor value					
	10,000	1,000	100	10	1	0
1.0	10,000	1,000	100	10	1	0
0.4	4,000	400	40	4	0.4	0
0.07	700	70	7	0.7	0.07	0
0.0007	7	0.7	0.07	0.007	0.0007	0

[a] Do not round to nearest integer.

4.1.2.3 *Drinking water threat-targets.* Evaluate the targets factor category for each watershed based on three factors: nearest intake, population, and resources.

To evaluate the nearest intake and population factors, determine whether the target surface water intakes are subject to actual or potential contamination as specified in section 4.1.1.2. Use either an observed release based on direct observation at the intake or the exposure concentrations from samples (or comparable samples) taken at or beyond the intake to make this determination (see section 4.1.2.1.1). The exposure concentrations for a sample (that is, surface water, benthic, or sediment sample) consist of the concentrations of those hazardous substances present that are significantly above background levels and attributable at least in part to the site (that is, those hazardous substance concentrations that meet the criteria for an observed release).

When an intake is subject to actual contamination, evaluate it using Level I concentrations or Level II concentrations. If the actual contamination is based on an observed release by direct observation, use Level II concentrations for that intake. However, if the actual contamination is based on an observed release from samples, determine which level applies for the intake by comparing the exposure concentrations from samples (or comparable samples) to health-based benchmarks as specified in sections 2.5.1 and 2.5.2. Use the health-based benchmarks from Table 3–10 (section 3.3.1) in determining the level of contamination from samples. For contaminated sediments with no identified source, evaluate the actual contamination using Level II concentrations (see section 4.1.1.2).

4.1.2.3.1 *Nearest intake.* Evaluate the nearest intake factor based on the drinking water intakes along the overland/flood hazardous substance migration path for the watershed. Include standby intakes in evaluating this factor only if they are used for supply at least once a year.

Assign the nearest intake factor a value as follows and enter the value in Table 4–1:

- If one or more of these drinking water intakes is subject to Level I concentrations as specified in section 4.1.2.3, assign a factor value of 50.
- If not, but if one or more of these drinking water intakes is subject to Level II concentrations, assign a factor value of 45.
- If none of these drinking water intakes is subject to Level I or Level II concentrations, determine the nearest of these drinking water intakes, as measured from the probable point of entry (or from the point where measurement begins for contaminated sediments with no identified source). Assign a dilution weight from Table 4–13 to this intake, based on the type of surface water body in which it is located. Multiply this dilution weight by 20, round the product to the nearest integer, and assign it as the factor value.

Assign the dilution weight from Table 4–13 as follows:

TABLE 4–13.—SURFACE WATER DILUTION WEIGHTS

Type of surface water body [a]		Assigned dilution weight [b]
Descriptor	Flow characteristics	
Minimal stream	Less than 10 cfs [c]	1
Small to moderate stream	10 to 100 cfs	0.1
Moderate to large stream	Greater than 100 to 1,000 cfs	0.01
Large stream to river	Greater than 1,000 to 10,000 cfs	0.001
Large river	Greater than 10,000 to 100,000 cfs	0.0001
Very large river	Greater than 100,000 cfs	0.00001
Coastal tidal waters [d]	Flow not applicable, depth not applicable	0.0001
Shallow ocean zone [e] or Great Lake	Flow not applicable, depth less than 20 feet	0.0001
Moderate depth ocean zone [e] or Great Lake	Flow not applicable, depth 20 to 200 feet	0.00001
Deep ocean zone [e] or Great Lake	Flow not applicable, depth greater than 200 feet	0.000005
3-mile mixing zone in quiet flowing river	10 cfs or greater	0.5

[a] Treat each lake as a separate type of water body and assign a dilution weight as specified in text.
[b] Do not round to nearest integer.
[c] cfs = cubic feet per second.
[d] Embayments; harbors, sounds, estuaries, back bays, lagoons, wetlands, etc., seaward from mouths of rivers and landward from baseline of Territorial Sea.
[e] Seaward from baseline of Territorial Sea. This baseline represents the generalized U.S. coastline. It is parallel to the seaward limit of the Territorial Sea and other maritime limits such as the inner boundary of the Federal fisheries jurisdiction and the limit of States jurisdiction under the Submerged Lands Act, as amended.

- For a river (that is, surface water body types specified in Table 4–13 as minimal stream through very large river), assign a dilution weight based on the average annual flow in the river at the intake. If available, use the average annual discharge as defined in the U.S. Geological Survey Water Resources Data Annual Report. Otherwise, estimate the average annual flow.
- For a lake, assign a dilution weight as follows:

–For a lake that has surface water flow entering the lake, assign a dilution weight based on the sum of the

For each type of surface water body, assign a dilution-weighted population value from Table 4–14, based on the number of people included for that type of surface water body. (Note that the dilution-weighted population values in Table 4–14 incorporate the dilution weights from Table 4–13. Do not multiply the values from Table 4–14 by these dilution weights.)

Calculate the value for the potential contamination factor (PC) for the watershed as follows:

$$PC = \frac{1}{10} \sum_{i=1}^{n} W_i$$

where:

W_i = Dilution-weighted population from Table 4–14 for surface water body type i.

n = Number of different surface water body types in the watershed.

If PC is less than 1, do not round it to the nearest integer; if PC is 1 or more, round to the nearest integer. Enter this value for the potential contamination factor in Table 4–1.

4.1.2.3.2.5 *Calculation of population factor value.* Sum the factor values for Level I concentrations, Level II concentrations, and potential contamination. Do not round this sum to the nearest integer. Assign this sum as the population factor value for the watershed. Enter this value in Table 4–1.

4.1.2.3.3 *Resources.* To evaluate the resources factor for the watershed, select the highest value below that applies to the watershed. Assign this value as the resources factor value for the watershed. Enter this value in Table 4–1.

Assign a value of 5 if, within the in-water segment of the hazardous substance migration path for the watershed, the surface water is used for one or more of the following purposes:

- Irrigation (5 acre minimum) of commercial food crops or commercial forage crops.
- Watering of commercial livestock.
- Ingredient in commercial food preparation.
- Major or designated water recreation area, excluding drinking water use.

Assign a value of 5 if, within the in-water segment of the hazardous substance migration path for the watershed, the surface water is not used for drinking water, but either of the following applies:

- Any portion of the surface water is designated by a State for drinking water use under section 305(a) of the Clean Water Act, as amended.
- Any portion of the surface water is usable for drinking water purposes.

Assign a value of 0 if none of the above applies.

4.1.2.3.4 *Calculation of drinking water threat-targets factor category value.* Sum the nearest intake, population, and resources factor values for the watershed. Do not round this sum to the nearest integer. Assign this sum as the drinking water threat-targets factor category value for the watershed. Enter this value in Table 4–1.

4.1.2.4 *Calculation of the drinking water threat score for a watershed.* Multiply the drinking water threat factor category values for likelihood of release, waste characteristics, and targets for the watershed, and round the product to the nearest integer. Then divide by 82,500. Assign the resulting value, subject to a maximum of 100, as the drinking water threat score for the watershed. Enter this value in Table 4–1.

4.1.3 *Human food chain threat.* Evaluate the human food chain threat for each watershed based on three factor categories: likelihood of release, waste characteristics, and targets.

4.1.3.1 *Human food chain threat-likelihood of release.* Assign the same likelihood of release factor category value for the human food chain threat for the watershed as would be assigned in section 4.1.2.1.3 for the drinking water threat. Enter this value in Table 4–1.

4.1.3.2 *Human food chain threat-waste characteristics.* Evaluate the waste characteristics factor category for each watershed based on two factors: toxicity/persistence/bioaccumulation and hazardous waste quantity.

4.1.3.2.1 *Toxicity/persistence/bioaccumulation.* Evaluate all those hazardous substances eligible to be evaluated for toxicity/persistence in the drinking water threat for the watershed (see section 4.1.2.2).

4.1.3.2.1.1 *Toxicity.* Assign a toxicity factor value to each hazardous substance as specified in section 2.4.1.1.

4.1.3.2.1.2 *Persistence.* Assign a persistence factor value to each hazardous substance as specified for the drinking water threat (see section 4.1.2.2.1.2), except: use the predominant water category (that is, lakes; or rivers, oceans, coastal tidal waters, or Great Lakes) between the probable point of entry and the nearest fishery (not the nearest drinking water or resources intake) along the hazardous substance migration path for the watershed to determine which portion of Table 4–10 to use. Determine the predominant water category based on distance as specified in section 4.1.2.2.1.2. For contaminated sediments with no identified source, use the point where measurement begins rather than the probable point of entry.

4.1.3.2.1.3 *Bioaccumulation potential.* Use the following data hierarchy to assign a bioaccumulation potential factor value to each hazardous substance:

- Bioconcentration factor (BCF) data.
- Logarithm of the n-octanol-water partition coefficient (log K_{ow}) data.
- Water solubility data.

Assign a bioaccumulation potential factor value to each hazardous substance from Table 4–15.

If BCF data are available for any aquatic human food chain organism for the substance being evaluated, assign the bioaccumulation potential factor value to the hazardous substance as follows:

- If BCF data are available for both fresh water and salt water for the hazardous substance, use the BCF data that correspond to the type of water body (that is, fresh water or salt water) in which the fisheries are located to assign the bioaccumulation potential factor value to the hazardous substance.
- If, however, some of the fisheries being evaluated are in fresh water and some are in salt water, or if any are in brackish water, use the BCF data that yield the higher factor value to assign the bioaccumulation potential factor value to the hazardous substance.
- If BCF data are available for either fresh water or salt water, but not for both, use the available BCF data to assign the bioaccumulation potential factor value to the hazardous substance.

If BCF data are not available for the hazardous substance, use log K_{ow} data to assign a bioaccumulation potential factor value to organic substances, but not to inorganic substances. If BCF data are not available, and if either log K_{ow} data are not available, the log K_{ow} is available but exceeds 6.0, or the substance is an inorganic substance, use water solubility data to assign a bioaccumulation potential factor value.

TABLE 4–15.—BIOACCUMULATION POTENTIAL FACTOR VALUES [a]

If bioconcentration factor (BCF) data are available for any aquatic human food chain organism, assign a value as follows: [b]

BCF	Assigned value
Greater than or equal to 10,000	50,000
1,000 to less than 10,000	5,000
100 to less than 1,000	500
10 to less than 100	50
1 to less than 10	5
Less than 1	0.5

If BCF data are not available, and log K_{ow} data are available and do not exceed 6.0, assign a value to an organic hazardous substance as follows (for inorganic hazardous substances, skip this step and proceed to the next):

Log K_{ow}	Assigned value
5.5 to 6.0	50,000
4.5 to less than 5.5	5,000
3.2 to less than 4.5	500
2.0 to less than 3.2	50
0.8 to less than 2.0	5
Less than 0.8	0.5

If BCF data are not available, and if either Log K_{ow} data are not available, a log K_{ow} is available but exceeds 6.0, or the substance is an inorganic substance, assign a value as follows:

TABLE 4-16
TOXICITY/PERSISTENCE/BIOACCUMULATION FACTOR VALUES[a]

Toxicity/ Persistence Factor Value	Bioaccumulation Potential Factor Value					
	50,000	5,000	500	50	5	0.5
10,000	5×10^8	5×10^7	5×10^6	5×10^5	5×10^4	5,000
4,000	2×10^8	2×10^7	2×10^6	2×10^5	2×10^4	2,000
1,000	5×10^7	5×10^6	5×10^5	5×10^4	5,000	500
700	3.5×10^7	3.5×10^6	3.5×10^5	3.5×10^4	3,500	350
400	2×10^7	2×10^6	2×10^5	2×10^4	2,000	200
100	5×10^6	5×10^5	5×10^4	5,000	500	50
70	3.5×10^6	3.5×10^5	3.5×10^4	3,500	350	35
40	2×10^6	2×10^5	2×10^4	2,000	200	20
10	5×10^5	5×10^4	5,000	500	50	5
7	3.5×10^5	3.5×10^4	3,500	350	35	3.5
4	2×10^5	2×10^4	2,000	200	20	2
1	5×10^4	5,000	500	50	5	0.5
0.7	3.5×10^4	3,500	350	35	3.5	0.35
0.4	2×10^4	2,000	200	20	2	0.2
0.07	3,500	350	35	3.5	0.35	0.035
0.007	350	35	3.5	0.35	0.035	0.0035
0.0007	35	3.5	0.35	0.035	0.0035	0.00035
0	0	0	0	0	0	0

[a]Do not round to nearest integer.

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4.1.3.2.2 *Hazardous waste quantity.* Assign the same factor value for hazardous waste quantity for the watershed as would be assigned in section 4.1.2.2.2 for the drinking water threat. Enter this value in Table 4–1.

4.1.3.2.3 *Calculation of human food chain threat-waste characteristics factor category value.* For the hazardous substance selected for the watershed in section 4.1.3.2.1.4, use its toxicity/persistence factor value and bioaccumulation potential factor value as follows to assign a value to the waste characteristics factor category. First, multiply the toxicity/persistence factor value and the hazardous waste quantity factor value for the watershed, subject to a maximum product of 1×10^{8}. Then multiply this product by the bioaccumulation potential factor value for this hazardous substance, subject to a maximum product of 1×10^{12}. Based on this second product, assign a value from Table 2–7 (section 2.4.3.1) to the human food chain threat-waste characteristics factor category for the watershed. Enter this value in Table 4–1.

4.1.3.3 *Human food chain threat-targets.* Evaluate two target factors for each watershed: food chain individual and population. For both factors, determine whether the target fisheries are subject to actual or potential human food chain contamination.

Consider a fishery (or portion of a fishery) within the target distance limit of the watershed to be subject to actual human food chain contamination if any of the following apply:

- A hazardous substance having a bioaccumulation potential factor value of 500 or greater is present either in an observed release by direct observation to the watershed or in a surface water or sediment sample from the watershed at a level that meets the criteria for an observed release to the watershed from the site, and at least a portion of the fishery is within the boundaries of the observed release (that is, it is located either at the point of direct observation or at or between the probable point of entry and the most distant sampling point establishing the observed release).
- The fishery is closed, and a hazardous substance for which the fishery has been closed has been documented in an observed release to the watershed from the site, and at least a portion of the fishery is within the boundaries of the observed release.
- A hazardous substance is present in a tissue sample from an essentially sessile, benthic, human food chain organism from the watershed at a level that meets the criteria for an observed release to the watershed from the site, and at least a portion of the fishery is within the boundaries of the observed release.

For a fishery that meets any of these three criteria, but that is not wholly within the boundaries of the observed release, consider only the portion of the fishery that is within the boundaries of the observed release to be subject to actual human food chain contamination. Consider the remainder of the fishery within the target distance limit to be subject to potential food chain contamination.

In addition, consider all other fisheries that are partially or wholly within the target distance limit for the watershed, including fisheries partially or wholly within the boundaries of an observed release for the watershed that do not meet any of the three criteria listed above, to be subject to potential human food chain contamination. If only a portion of the fishery is within the target distance limit for the watershed, include only that portion in evaluating the targets factor category.

When a fishery (or portion of a fishery) is subject to actual food chain contamination, determine the part of the fishery subject to Level I concentrations and the part subject to Level II concentrations. If the actual food chain contamination is based on direct observation, evaluate it using Level II concentrations. However, if the actual food chain contamination is based on samples from the watershed, use these samples and, if available, additional tissue samples from aquatic human food chain organisms as specified below, to determine the part subject to Level I concentrations and the part subject to Level II concentrations:

- Determine the level of actual contamination from samples (including tissue samples from essentially sessile, benthic organisms) that meet the criteria for actual food chain contamination by comparing the exposure concentrations (see section 4.1.2.3) from these samples (or comparable samples) to the health-based benchmarks from Table 4–17, as described in section 2.5.1 and 2.5.2. Use only the exposure concentrations for those hazardous substances in the sample (or comparable samples) that meet the criteria for actual contamination of the fishery.
- In addition, determine the level of actual contamination from other tissue samples by comparing the concentrations of hazardous substances in the tissue samples (or comparable tissue samples) to the health-based benchmarks from Table 4–17, as described in sections 2.5.1 and 2.5.2. Use only those additional tissue samples and only those hazardous substances in the tissue samples that meet all the following criteria:
  - –The tissue sample is from a location that is within the boundaries of the actual food chain contamination for the site (that is, either at the point of direct observation or at or between the probable point of entry and the most distant sample point meeting the criteria for actual food chain contamination).
  - –The tissue sample is from a species of aquatic human food chain organism that spends extended periods of time within the boundaries of the actual food chain contamination for the site and that is not an essentially sessile, benthic organism.
  - –The hazardous substance is a substance that is also present in a surface water, benthic, or sediment sample from within the target distance limit for the watershed and, for such a sample, meets the criteria for actual food chain contamination.

TABLE 4–17.—HEALTH-BASED BENCHMARKS FOR HAZARDOUS SUBSTANCES IN HUMAN FOOD CHAIN

- Concentration corresponding to Food and Drug Administration Action Level (FDAAL) for fish or shellfish.
- Screening concentration for cancer corresponding to that concentration that corresponds to the 10^{-6} individual cancer risk for oral exposures.
- Screening concentration for noncancer toxicological responses corresponding to the Reference Dose (RfD) for oral exposures.

4.1.3.3.1 *Food chain individual.* Evaluate the food chain individual factor based on the fisheries (or portions of fisheries) within the target distance limit for the watershed. Assign this factor a value as follows:

- If any fishery (or portion of a fishery) is subject to Level I concentrations, assign a value of 50.
- If not, but if any fishery (or portion of a fishery) is subject to Level II concentrations, assign a value of 45.
- If not, but if there is an observed release of a hazardous substance having a bioaccumulation potential factor value of 500 or greater to surface water in the watershed and there is a fishery (or portion of a fishery) present anywhere within the target distance limit, assign a value of 20.
- If there is no observed release to surface water in the watershed or there is no observed release of a hazardous substance having a bioaccumulation potential factor value of 500 or greater, but there is a fishery (or portion of a fishery) present anywhere within the target distance limit, assign a value as follows:
  - –Using Table 4–13, determine the highest dilution weight (that is, lowest amount of dilution) applicable to the fisheries (or portions of fisheries) within the target distance limit. Multiply this dilution weight by 20 and round to the nearest integer.
  - –Assign this calculated value as the factor value.
- If there are no fisheries (or portions of fisheries) within the target distance limit of the watershed, assign a value of 0.

Enter the value assigned in Table 4–1.

4.1.3.3.2 *Population.* Evaluate the population factor for the watershed based on three factors: Level I concentrations, Level II concentrations, and potential human food chain contamination. Determine which factor applies for a fishery (or portion of a fishery) as specified in section 4.1.3.3.

4.1.3.3.2.1 *Level I concentrations.* Determine those fisheries (or portions of fisheries) within the watershed that are subject to Level I concentrations.

Estimate the human food chain population value for each fishery (or portion of a fishery) as follows:

- Estimate human food chain production for the fishery based on the estimated annual

production (in pounds) of human food chain organisms (for example, fish, shellfish) for that fishery, except: if the fishery is closed and a hazardous substance for which the fishery has been closed has been documented in an observed release to the fishery from a source at the site, use the estimated annual production for the period prior to closure of the fishery or use the estimated annual production from comparable fisheries that are not closed.

• Assign the fishery a value for human food chain population from Table 4–18, based on the estimated human food production for the fishery.

• Set boundaries between fisheries at those points where human food chain production changes or where the surface water dilution weight changes.

Sum the human food chain population value for each fishery (and portion of a fishery). Multiply this sum by 10. If the product is less than 1, do not round it to the nearest integer; if 1 or more, round to the nearest integer. Assign the resulting value as the Level I concentrations factor value. Enter this value in Table 4–1.

4.1.3.3.2.2 *Level II concentrations.* Determine those fisheries (or portions of fisheries) within the watershed that are subject to Level II concentrations. Do not include any fisheries (or portions of fisheries) already counted under the Level I concentrations factor.

Assign each fishery (or portion of a fishery) a value for human food chain population from Table 4–18, based on the estimated human food production for the fishery. Estimate the human food chain production for the fishery as specified in section 4.1.3.3.2.1.

Sum the human food chain population value for each fishery (and portion of a fishery). If this sum is less than 1, do not round it to the nearest integer; if 1 or more, round to the nearest integer. Assign the resulting value as the Level II concentrations factor value. Enter this value in Table 4–1.

TABLE 4–18.—HUMAN FOOD CHAIN POPULATION VALUES [a]

Human food chain production (pounds per year)	Assigned human food chain population value
0	0
Greater than 0 to 100	0.03
Greater than 100 to 1,000	0.3
Greater than 1,000 to 10,000	3
Greater than 10,000 to 100,000	31
Greater than 100,000 to 1,000,000	310
Greater than 10^6 to 10^7	3,100
Greater than 10^7 to 10^8	31,000
Greater than 10^8 to 10^9	310,000
Greater than 10^9	3,100,000

[a] Do not round to nearest integer.

4.1.3.3.2.3 *Potential human food chain contamination.* Determine those fisheries (or portions of fisheries) within the watershed that are subject to potential human food chain contamination. Do not include those fisheries (or portion of fisheries) already counted under the Level I or Level II concentrations factors.

Calculate the value for the potential human food chain contamination factor (PF) for the watershed as follows:

$$PF = \frac{1}{10} \sum_{i=1}^{n} P_i D_i$$

where:

P_i = Human food chain population value for fishery i.

D_i = Dilution weight from Table 4–13 for fishery i.

n = Number of fisheries subject to potential human food chain contamination.

In calculating PF:

• Estimate the human food chain population value (P_i) for a fishery (or portion of a fishery) as specified in section 4.1.3.3.2.1.

• Assign the fishery (or portion of a fishery) a dilution weight as indicated in Table 4–13 (section 4.1.2.3.1), except: do not assign a dilution weight of 0.5 for a "3-mile mixing zone in quiet flowing river"; instead assign a dilution weight based on the average annual flow.

If PF is less than 1, do not round it to the nearest integer; if PF is 1 or more, round to the nearest integer. Enter the value assigned in Table 4–1.

4.1.3.3.2.4 *Calculation of population factor value.* Sum the values for the Level I concentrations, Level II concentrations, and potential human food chain contamination factors for the watershed. Do not round this sum to the nearest integer. Assign it as the population factor value for the watershed. Enter this value in Table 4–1.

4.1.3.3.3 *Calculation of human food chain threat-targets factor category value.* Sum the food chain individual and population factor values for the watershed. Do not round this sum to the nearest integer. Assign it as the human food chain threat-targets factor category value for the watershed. Enter this value in Table 4–1.

4.1.3.4 *Calculation of human food chain threat score for a watershed.* Multiply the human food chain threat factor category values for likelihood of release, waste characteristics, and targets for the watershed, and round the product to the nearest integer. Then divide by 82,500. Assign the resulting value, subject to a maximum of 100, as the human food chain threat score for the watershed. Enter this score in Table 4–1.

4.1.4 *Environmental threat.* Evaluate the environmental threat for the watershed based on three factor categories: likelihood of release, waste characteristics, and targets.

4.1.4.1 *Environmental threat-likelihood of release.* Assign the same likelihood of release factor category value for the environmental threat for the watershed as would be assigned in section 4.1.2.1.3 for the drinking water threat. Enter this value in Table 4–1.

4.1.4.2 *Environmental threat-waste characteristics.* Evaluate the waste characteristics factor category for each watershed based on two factors: ecosystem toxicity/persistence/bioaccumulation and hazardous waste quantity.

4.1.4.2.1 *Ecosystem toxicity/persistence/bioaccumulation.* Evaluate all those hazardous substances eligible to be evaluated for toxicity/persistence in the drinking water threat for the watershed (see section 4.1.2.2).

4.1.4.2.1.1 *Ecosystem toxicity.* Assign an ecosystem toxicity factor value from Table 4–19 to each hazardous substance on the basis of the following data hierarchy:

• EPA chronic Ambient Water Quality Criterion (AWQC) for the substance.

• EPA chronic Ambient Aquatic Life Advisory Concentrations (AALAC) for the substance.

• EPA acute AWQC for the substance.

• EPA acute AALAC for the substance.

• Lowest LC_{50} value for the substance.

In assigning the ecosystem toxicity factor value to the hazardous substance:

• If either an EPA chronic AWQC or AALAC is available for the hazardous substance, use it to assign the ecosystem toxicity factor value. Use the chronic AWQC in preference to the chronic AALAC when both are available.

• If neither is available, use the EPA acute AWQC or AALAC to assign the ecosystem toxicity factor value. Use the acute AWQC in preference to the acute AALAC.

• If none of the chronic and acute AWQCs and AALACs is available, use the lowest LC_{50} value to assign the ecosystem toxicity factor value.

• If an LC_{50} value is also not available, assign an ecosystem toxicity factor value of 0 to the hazardous substance and use other hazardous substances for which data are available in evaluating the pathway.

If an ecosystem toxicity factor value of 0 is assigned to all hazardous substances eligible to be evaluated for the watershed (that is, insufficient data are available for evaluating all the substances), use a default value of 100 as the ecosystem toxicity factor value for all these hazardous substances.

With regard to the AWQC, AALAC, or LC_{50} selected for assigning the ecosystem toxicity factor value to the hazardous substance:

• If values for the selected AWQC, AALAC, or LC_{50} are available for both fresh water and marine water for the hazardous substance, use the value that corresponds to the type of water body (that is, fresh water or salt water) in which the sensitive environments are located to assign the ecosystem toxicity factor value to the hazardous substance.

• If, however, some of the sensitive environments being evaluated are in fresh water and some are in salt water, or if any are in brackish water, use the value (fresh water or marine) that yields the higher factor value to assign the ecosystem toxicity factor value to the hazardous substance.

• If a value for the selected AWQC, AALAC, or LC_{50} is available for either fresh water or marine water, but not for both, use the available one to assign an ecosystem toxicity factor value to the hazardous substance.

TABLE 4-19.—ECOSYSTEM TOXICITY FACTOR VALUES

If an EPA chronic AWQC[a] or AALAC[b] is available, assign a value as follows:[c]

EPA chronic AWQC or AALAC	Assigned value
Less than 1 µg/l	10,000
1 to 10 µg/l	1,000
Greater than 10 to 100 µg/l	100
Greater than 100 to 1,000 µg/l	10
Greater than 1,000 µg/l	1

If neither an EPA chronic AWQC nor EPA chronic AALAC is available, assign a value based on the EPA acute AWQC or AALAC as follows:[c]

EPA acute AWQC or AALAC	Assigned value
Less than 100 µg/l	10,000
100 to 1,000 µg/l	1,000
Greater than 1,000 to 10,000 µg/l	100
Greater than 10,000 to 100,000 µg/l	10
Greater than 100,000 µg/l	1

TABLE 4-19. ECOSYSTEM TOXICITY FACTOR VALUES—Concluded

If neither an EPA chronic or acute AWQC nor EPA chronic or acute AALAC is available, assign a value from the LC_{50} as follows:

EPA acute AWQC or AALAC

LC_{50}	Assigned value
Less than 100 µg/l	10,000
100 to 1,000 µg/l	1,000
Greater than 1,000 to 10,000 µg/l	100
Greater than 10,000 to 100,000 µg/l	10
Greater than 100,000 µg/l	1

If none of the AWQCs and AALACs nor the LC_{50} is available, assign a value of 0.

[a] AWQC—Ambient Water Quality Criteria.
[b] AALAC—Ambient Aquatic Life Advisory Concentrations.
[c] Use the AWQC value in preference to the AALAC when both are available. See text for use of freshwater and marine values.

4.1.4.2.1.2 *Persistence.* Assign a persistence factor value to each hazardous substance as specified in section 4.1.2.2.1.2, except: use the predominant water category (that is lakes, or rivers, oceans, coastal tidal waters, or Great Lakes) between the probable point of entry and the nearest sensitive environment (not the nearest drinking water or resources intake) along the hazardous substance migration path for the watershed to determine which portion of Table 4-20 to use. Determine the predominant water category based on distance as specified in section 4.1.2.2.1.2. For contaminated sediments with no identified source, use the point where measurement begins rather than the probable point of entry.

4.1.4.2.1.3 *Ecosystem bioaccumulation potential.* Assign an ecosystem bioaccumulation potential factor value to each hazardous substance in the same manner specified for the bioaccumulation potential factor in section 4.1.3.2.1.3, except:

- Use BCF data for all aquatic organisms, not just for aquatic human food chain organisms.
- Use the BCF data that corresponds to the type of water body (that is, fresh water or salt water) in which the sensitive environments (not fisheries) are located.

4.1.4.2.1.4 *Calculation of ecosystem toxicity/persistence/bioaccumulation factor value.* Assign each hazardous substance an ecosystem toxicity/persistence factor value from Table 4-20, based on the values assigned to the hazardous substance for the ecosystem toxicity and persistence factors. Then assign each hazardous substance an ecosystem toxicity/persistence/bioaccumulation factor value from Table 4-21, based on the values assigned for the ecosystem toxicity/persistence and ecosystem bioaccumulation potential factors. Select the hazardous substance with the highest ecosystem toxicity/persistence/bioaccumulation factor value for the watershed and use it to assign the value to this factor. Enter this value in Table 4-1.

TABLE 4-20.—ECOSYSTEM TOXICITY/PERSISTENCE FACTOR VALUES[a]

Persistence factor value	Ecosystem toxicity factor value					
	10,000	1,000	100	10	1	0
1.0	10,000	1,000	100	10	1	0
0.4	4,000	400	40	4	0.4	0
0.07	700	70	7	0.7	0.07	0
0.0007	7	0.7	0.07	0.007	0.0007	0

[a] Do not round to nearest integer.

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4.1.4.2.2. *Hazardous waste quantity.* Assign the same factor value for hazardous waste quantity for the watershed as would be assigned in section 4.1.2.2.2 for the drinking water threat. Enter this value in Table 4-1.

4.1.4.2.3 *Calculation of environmental threat-waste characteristics factor category value.* For the hazardous substance selected for the watershed in section 4.1.4.2.1.4, use its ecosystem toxicity/persistence factor value and ecosystem bioaccumulation potential factor value as follows to assign a value to the waste characteristics factor category. First, multiply the ecosystem toxicity/persistence factor value and the hazardous waste quantity factor value for the watershed, subject to a maximum product of 1×10^8. Then multiply this product by the ecosystem bioaccumulation potential factor value for this hazardous substance, subject to a maximum product of 1×10^{12}. Based on this second product, assign a value from Table 2-7 (section 2.4.3.1) to the environmental threat-waste characteristics factor category for the watershed. Enter this value in Table 4-1.

TABLE 4-22.—ECOLOGICAL-BASED BENCHMARKS FOR HAZARDOUS SUBSTANCES IN SURFACE WATER

- Concentration corresponding to EPA Ambient Water Quality Criteria (AWQC) for protection of aquatic life (fresh water or marine).
- Concentration corresponding to EPA Ambient Aquatic Life Advisory Concentrations (AALAC).
- Select the appropriate AWQC and AALAC as follows:
  - –Use chronic value, if available; otherwise use acute value.
  - –If the sensitive environment being evaluated is in fresh water, use fresh water value, except: if no fresh water value is available, use marine value if available.
  - –If the sensitive environment being evaluated is in salt water, use marine value, except: if no marine value is available, use fresh water value if available.
  - –If the sensitive environment being evaluated is in both fresh water and salt water, or is in brackish water, use lower of fresh water or marine values.

TABLE 4-23.—SENSITIVE ENVIRONMENTS RATING VALUES

Sensitive environment	Assigned value
Critical habitat [a] for Federal designated endangered or threatened species	100
Marine Sanctuary	
National Park	
Designated Federal Wilderness Area	
Areas identified under Coastal Zone Management Act [b]	
Sensitive areas identified under National Estuary Program [c] or Near Coastal Waters Program [d]	
Critical areas identified under the Clean Lakes Program [e]	
National Monument [f]	
National Seashore Recreational Area	
National Lakeshore Recreational Area	
Habitat known to be used by Federal designated or proposed endangered or threatened species	75
National Preserve	
National or State Wildlife Refuge	
Unit of Coastal Barrier Resources System	
Coastal Barrier (undeveloped)	
Federal land designated for protection of natural ecosystems	
Administratively Proposed Federal Wilderness Area	
Spawning areas critical [g] for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters	
Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time	
Terrestrial areas utilized for breeding by large or dense aggregations of animals [h]	
National river reach designated as Recreational	
Habitat known to be used by State designated endangered or threatened species	50
Habitat known to be used by species under review as to its Federal endangered or threatened status	
Coastal Barrier (partially developed)	
Federal designated Scenic or Wild River	
State land designated for wildlife or game management	25
State designated Scenic or Wild River	
State designated Natural Areas	
Particular areas, relatively small in size, important to maintenance of unique biotic communities	
State designated areas for protection or maintenance of aquatic life [i]	5

[a] Critical habitat as defined in 50 CFR 424.02.
[b] Areas identified in State Coastal Zone Management plans as requiring protection because of ecological value.
[c] National Estuary Program study areas (subareas within estuaries) identified in Comprehensive Conservation and Management Plans as requiring protection because they support critical life stages of key estuarine species (Section 320 of Clean Water Act, as amended).
[d] Near Coastal Waters as defined in Sections 104(b)(3), 304(1), 319, and 320 of Clean Water Act, as amended.
[e] Clean Lakes Program critical areas (subareas within lakes, or in some cases entire small lakes) identified by State Clean Lake Plans as critical habitat (Section 314 of Clean Water Act, as amended).
[f] Use only for air migration pathway.
[g] Limit to areas described as being used for intense or concentrated spawning by a given species.
[h] For the air migration pathway, limit to terrestrial vertebrate species. For the surface water migration pathway, limit to terrestrial vertebrate species with aquatic or semiaquatic foraging habits.
[i] Areas designated under Section 305(a) of Clean Water Act, as amended.

TABLE 4–24.—WETLANDS RATING VALUES FOR SURFACE WATER MIGRATION PATHWAY

Total length of wetlands * (miles)	Assigned value
Less than 0.1	0
0.1 to 1	25
Greater than 1 to 2	50
Greater than 2 to 3	75
Greater than 3 to 4	100
Greater than 4 to 8	150
Greater than 8 to 12	250
Greater than 12 to 16	350
Greater than 16 to 20	450
Greater than 20	500

* Wetlands as defined in 40 CFR Section 230.3.

4.1.4.3 *Environmental threat-targets.* Evaluate the environmental threat-targets factor category for a watershed using one factor: sensitive environments.

4.1.4.3.1 *Sensitive environments.* Evaluate sensitive environments along the hazardous substance migration path for the watershed based on three factors: Level I concentrations, Level II concentrations, and potential contamination.

Determine which factor applies to each sensitive environment as specified in section 4.1.2.3, except: use ecological-based benchmarks (Table 4–22) rather than health-based benchmarks (Table 3–10) in determining the level of contamination from samples. In determining the level of actual contamination, use a point of direct observation anywhere within the sensitive environment or samples (that is, surface water, benthic, or sediment samples) taken anywhere within or beyond the sensitive environment (or anywhere adjacent to or beyond the sensitive environment if it is contiguous to the migration path).

4.1.4.3.1.1 *Level I concentrations.* Assign value(s) from Table 4–23 to each sensitive environment subject to Level I concentrations.

For those sensitive environments that are wetlands, assign an additional value from Table 4–24. In assigning a value from Table 4–24, include only those portions of wetlands located along the hazardous substance migration path in the area of Level I concentrations. If a wetland is located partially along the area of Level I concentrations and partially along the area of Level II concentrations and/or potential contamination, then solely for purposes of Table 4–24, count the portion(s) along the areas of Level II concentrations or potential contamination under the Level II concentrations factor (section 4.1.4.3.1.2) or potential contamination factor (section 4.1.4.3.1.3), as appropriate.

Estimate the total length of wetlands along the hazardous substance migration path (that is, wetland frontage) in the area of Level I concentrations and assign a value from Table 4–24 based on this total length. Estimate this length as follows:

- For an isolated wetland or for a wetland where the probable point of entry to surface water is in the wetland, use the perimeter of that portion of the wetland subject to Level I concentrations as the length.
- For rivers, use the length of the wetlands contiguous to the in-water segment of the hazardous substance migration path (that is, wetland frontage).
- For lakes, oceans, coastal tidal waters, and Great Lakes, use the length of the wetlands along the shoreline within the target distance limit (that is, wetland frontage along the shoreline).

Calculate the Level I concentrations factor value (SH) for the watershed as follows:

$$SH = 10(WH + \sum_{i=1}^{n} S_i)$$

where:

WH = Value assigned from Table 4–24 to wetlands along the area of Level I concentrations.

S_i = Value(s) assigned from Table 4–23 to sensitive environment i.

n = Number of sensitive environments from Table 4–23 subject to Level I concentrations.

Enter the value assigned in Table 4–1.

4.1.4.3.1.2 *Level II concentrations.* Assign value(s) from Table 4–23 to each sensitive environment subject to Level II concentrations. Do not include sensitive environments already counted for Table 4–23 under the Level I concentrations factor for this watershed.

For those sensitive environments that are wetlands, assign an additional value from Table 4–24. In assigning a value from Table 4–24, include only those portions of wetlands located along the hazardous substance migration path in the area of Level II concentrations, as specified in section 4.1.4.3.1.1.

Estimate the total length of wetlands along the hazardous substance migration path (that is, wetland frontage) in the area of Level II concentrations and assign a value from Table 4–24 based on this total length. Estimate this length as specified in section 4.1.4.3.1.1, except: for an isolated wetland or for a wetland where the probable point of entry to surface water is in the wetland, use the perimeter of that portion of the wetland subject to Level II (not Level I) concentrations as the length.

Calculate the Level II concentrations value (SL) for the watershed as follows:

$$SL = WL + \sum_{i=1}^{n} S_i$$

where:

WL = Value assigned from Table 4–24 to wetlands along the area of Level II concentrations.

S_i = Value(s) assigned from Table 4–23 to sensitive environment i.

n = Number of sensitive environments from Table 4–23 subject to Level II concentrations.

Enter the value assigned in Table 4–1.

4.1.4.3.1.3 *Potential contamination.* Assign value(s) from Table 4–23 to each sensitive environment subject to potential contamination. Do not include sensitive environments already counted for Table 4–23 under the Level I or Level II concentrations factors.

For each type of surface water body in Table 4–13 (section 4.1.2.3.1), sum the value(s) assigned from Table 4–23 to the sensitive environments along that type of surface water body, except: do not use the surface water body type "3-mile mixing zone in quiet flowing river." If a sensitive environment is along two or more types of surface water bodies (for example, Wildlife Refuge contiguous to both a moderate stream and a large river), assign the sensitive environment only to that surface water body type having the highest dilution weight value from Table 4–13.

For those sensitive environments that are wetlands, assign an additional value from Table 4–24. In assigning a value from Table 4–24, include only those portions of wetlands located along the hazardous substance migration path in the area of potential contamination, as specified in section 4.1.4.3.1.1. Aggregate these wetlands by type of surface water body, except: do not use the surface water body type "3-mile mixing zone in quiet flowing river." Treat the wetlands aggregated within each type of surface water body as separate sensitive environments solely for purposes of applying Table 4–24. Estimate the total length of the wetlands within each surface water body type as specified in section 4.1.4.3.1.1, except: for an isolated wetland or for a wetland where the probable point of entry to surface water is in the wetland, use the perimeter of that portion of the wetland subject to potential contamination (or the portion of that perimeter that is within the target distance limit) as the length. Assign a separate value from Table 4–24 for each type of surface water body in the watershed.

Calculate the potential contamination factor value (SP) for the watershed as follows:

$$SP = \frac{1}{10} \sum_{j=1}^{m} ([W_j + S_{ij}]D_j)$$

where:

$$S_{ij} = \sum_{i=1}^{n} S_{ij}$$

S_{ij} = Value(s) assigned from Table 4–23 to sensitive environment i in surface water body type j.

n = Number of sensitive environments from Table 4–23 subject to potential contamination.

W_j = Value assigned from Table 4–24 for wetlands along the area of potential contamination in surface water body type j.

D_j = Dilution weight from Table 4–13 for surface water body type j.

m = Number of different surface water body types from Table 4–13 in the watershed.

If SP is less than 1, do not round it to the nearest integer; if SP is 1 or more, round to the nearest integer. Enter this value for the potential contamination factor in Table 4–1.